

non-minimal SUSY models

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There is life beyond the MSSM

The MSSM has been the top candidate for BSM physics for many years. However, there are good reasons to look beyond the MSSM.

- **Higgs mass/Naturalness** → F - or D -term enhanced mass?
- **Missing signals for SUSY at LHC**
→ compressed spectra? R -parity violation? split-SUSY? ...
- **Neutrino masses** → R -parity violation? Seesaw mechanism?
- **The μ problem** → effective μ term?
- **Strong CP problem** → (gauged?) Peccei-Quinn symmetry?
- **R symmetry** → Dirac Gauginos?
- **GUT/String model** → extended gauge sector? Z' , W' in reach?
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→ There are many models on the market which deserve a closer look

Computer tools

I develop tools to study BMSSM models with high precision

SARAH

[sarah.hepforge.org]

Mathematica package to explore analytical properties ([vertices](#), [masses](#), [RGEs](#), [self-energies](#)) of SUSY and non-SUSY models.

Writes [model files](#) for MC tools ([MadGraph](#), [WHIZARD](#), [CalcHep](#)) as well as other tools ([FeynArts/FormCalc](#), [SPheno](#), [Vevacious](#)).

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Fortran code for [numerical exploration of a model](#). Main features: [two-loop RGEs](#), [loop corrections](#) to SUSY and Higgs states, [decay widths](#) and [branching ratios](#), interface to HiggsBounds [with Porod]

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Vevacious

[vevacious.hepforge.org]

Tool to check the [stability](#) of the [scalar potential at one-loop](#). CosmoTransition linked to get an estimate of the [life time](#) for meta-stable vacua. [with Camargo, O'Leary, Porod]

FlavorKit

Linking FeynArts/FormCalc-SARAH-SPheno to allow for a **fully** automatized calculation of flavor observables in BSM models at one-loop level

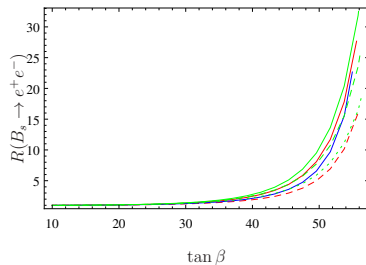
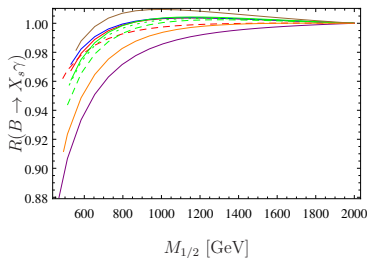
[with Porod, Vicente]

Recent developments I

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FlavorKit, SPhenoMSSM (dashed), SPheno 3.3, SUSY_Flavor 1, SUSY_Flavor 2, MicrOmegas, SuperIso

Two-loop Higgs masses

Implementation of **two-loop Higgs mass** calculation in the SARAH–SPheno interface. This allows a **prediction of the Higgs mass** in **non-minimal SUSY models** with the **same accuracy** spectrum generators provide **for the MSSM**.

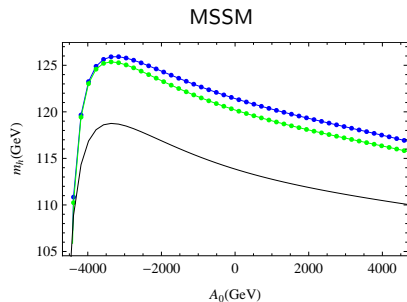
[with Goodsell, Nickel]

Recent developments II

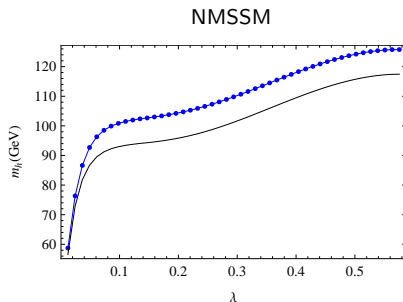
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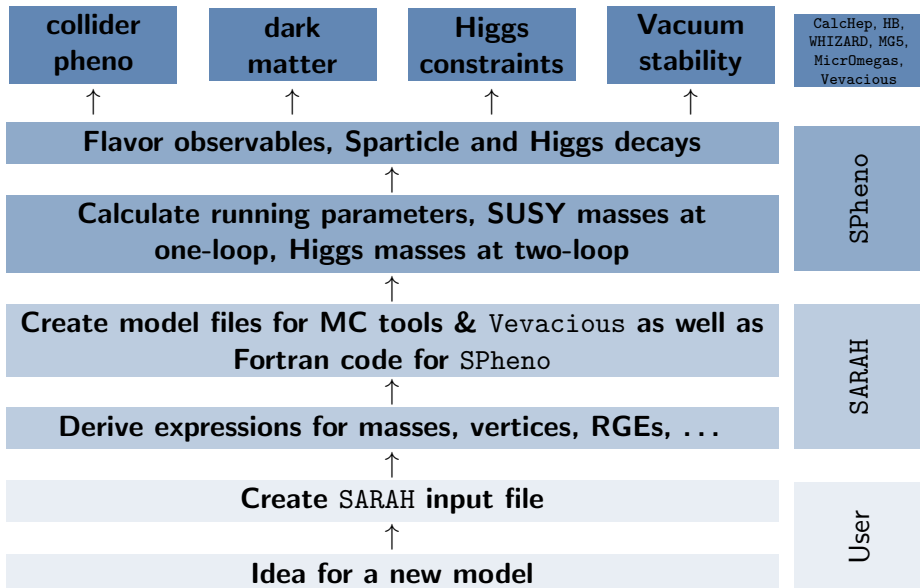


one-loop / $\alpha_S(\alpha_b + \alpha_t)$ / full two-loop



one-loop / $\alpha_S(\alpha_b + \alpha_t)$

Framework to study BMSSM models



Topics of on-going projects (making use of that framework):

- **Two-loop Higgs masses in the NMSSM and trilinear R -parity violation** [with Goodsell, Nickel, Dreiner]
- **Phenomenology of a constrained model with Dirac Gauginos** [with Benakli, Emken, Goodsell, Krauss, Porod]
- **Phenomenology of $SO(10)$ models with sliding scales** [with Hirsch, Opferkuch]
- **Phenomenology of triplet extensions** [with Li, Ding, Zhu]